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According to the custom of our navigators, the longitude has been calculated from Greenwich, although this point has not been visited by the expedition; yet, as the difference of the longitude of Greenwich and that of Altona, the most western point of our chain, is exactly known, it was easy to reduce all the longitudes to the meridian of Greenwich. The latitudes have also been added, as ascertained by former astronomical observations, or determined by the last triangulation, also executed under the direction of Lieut.-Gen. Schubert, as well as by observations made during this expedition.

III.—*On Ground-Ice** *in the Siberian Rivers.* Communicated by Colonel Jackson, F.R.G.S., (St. Petersburg).

EVERY observation made by the naturalist, which seems to contradict the laws of nature, is condemned to disbelief till the accumulation of evidence forces from scepticism an acknowledgment of conviction. The existence of granite superimposed to secondary rocks, so long denied, is now a fact received and accounted for. In like manner the phenomenon of ice formed at the bottom of rivers has been too frequently observed, and too well authenticated, to admit of further doubt, and now only requires to be satisfactorily explained. As it is but very lately, however, that the subject appears to have engaged attention, fresh observations are still desirable, and I doubt not but the present translation of an article, written by Mr. Weitz †, and as yet unpublished, will be read with interest:—

" In traversing the rapid rivers of the north, in the beginning of the winter, it is easy to persuade oneself of the formation of ground-ice. These rivers, near their sources in the high lands, flow with great rapidity over a sandy or stony bed, and, notwithstanding the intensity and duration of the cold, and the abundance of snow, they continue to flow, bearing along vast quantities of floating ice, brought from their source, and augmented by what is detached from the sides, as also by what rises from the bottom.

" The Kann is a river of this kind; it takes its rise in a branch of the Saiansk mountains, and empties itself into the Jeneseï, forty versts from Krasnojarsk. I traversed this river in November, after much hard frost, and had an opportunity of observing the formation of ice at the bottom. The ice presents itself in the form of long prismatic and pyramidal crystals, collected sometimes into large masses reposing on the bottom, from which they seem to grow. The great transparency of these rivers enables us to see clearly what is at the bottom. At a depth of fourteen feet and more one might see the ice formed at the bottom, whose greenish tinge gave it an appearance somewhat similar to that of patches of the *confervoideæ*. Sometimes these masses, without any visible cause, get detached from the bottom, rise to the surface, and, becoming more compact by contact with the cold air, are floated away with the other flakes. It frequently happens that these pieces, in rising from the bottom, bring up with them sand and stones, which are thus transported by the current. Arrived at those parts of the river where, from the very little slope of the bed, the motion of the water is slow, and where the surface is sometimes frozen over, these floating masses collect, rub against each other, and get fixed; whence the inhabitants affirm that the river first freezes towards the lower part of the stream, and that from thence the congelation proceeds upwards till it reaches the higher and most rapid parts. Others assert that, where the water is shallow the ice begins to form at the bottom, and increases upwards by degrees till it gains the surface; thus forming a barrier to the ice-meers which come down, and contributing by this means to the congelation of the surface of the whole river. When the thaw sets in, the ice becoming rotten lets fall the gravel and stones in places far distant from those whence they came.

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* I by no means approve of the term ground-ice as applied to that which is formed at the bottom of rivers, and merely use it in conformity with custom. I think the term *bottom-ice*, though certainly less elegant, more explicit. I would confine the term *ground-ice* to that which is sometimes found a few feet below the surface of the soil in the ground itself.

† Superior Officer of the Imperial Russian Mining Corps. The original is in Russ.

"This phenomenon has as yet been remarked by myself only in the river Kann, but it is seen in the Angara, which passes near Irkoutsk, and several persons have observed it in the Wolga. It is my opinion that it must be common to all the rivers of the north, whose rapidity prevents their freezing at the surface, notwithstanding the intensity and duration of the cold. If I hazard an explanation, founded on physical laws, it is with diffidence, and in the hope of inviting to the subject the attention of those better able than myself to do it justice.

"I conceive that the intensity and long continuance of the cold may freeze the soil to the depth of the bottom of the river, particularly where it is not deep, and that there the diminished velocity of the water permits its congelation, particularly if there be any hollows, where the water remains stagnant. So long as the congealed masses continue small with regard to the volume of water immediately above them, they adhere as if rooted to the bottom, but when by degrees they increase in bulk, the difference in their specific gravity operates to overcome their adhesion to the bottom, and they rise, bringing with them, as we have said, such gravel and stones as we find attached to them; whence we may conclude that not only does the current occasion a change in the bed of the river by its erosion of the looser soil which it carries from one place to depose in another, but that the ice which forms at the bottom of rapid rivers, in very cold countries, tends also to effect a change in the beds of those rivers."

There can be no doubt of the truth of the facts above stated. It were desirable that Mr. Weitz had been more particular in describing the nature of the crystalline forms of the ground-ice of which he speaks; it seems to differ entirely from the scaly formation mentioned in the paper on the congelation of the Neva, as well as from the concreted cauliflower-like masses mentioned by Dr. Farquharson in the paper lately read before the Royal Society. All the observations hitherto made confirm the fact that the process of freezing is different at the bottom of a river from what it is at the surface. The greenish colour of the bottom-ice, as observed by Mr. Weitz, is also a remarkable circumstance.

I am ignorant of the details of both Mr. Arago's and Dr. Farquharson's observations, and therefore know not whether or not these gentlemen and others have ascertained the temperature of the water in its whole mass when they found *bottom-ice*. This I think essential to any satisfactory explanation of the phenomenon in question. Mr. Weitz's opinion is the same as that entertained by myself, and accounts, I think, very naturally for the formation of the *bottom-ice*. I can with difficulty admit radiation as the cause, and still less a precipitation of hoar-frost, according to Mr. Easedale's theory. I strongly suspect that no congelation can take place at the bottom of a river but when the whole mass of its waters are at, or very near, zero, in which case the water will freeze wherever the motion is sufficiently retarded. If, as Mr. Farquharson observes, rivers are often raised above their usual level in consequence of the formation of *bottom-ice*, the quantity must be great indeed; for water in freezing increases too little in bulk, one would think, to produce so great an effect.

But to return to Mr. Weitz. He seems, I think, to attribute too much influence to the bottom-ice, in supposing that the quantity of sand and gravel which it displaces can in any way assist in effecting a change in the bed of the river.

Without further comment, I shall conclude by expressing a wish that carefully directed observations were made in different parts of the world, and under different circumstances, with a view to increase the number of facts, and to ascertain with certainty the law by which the phenomenon is regulated.